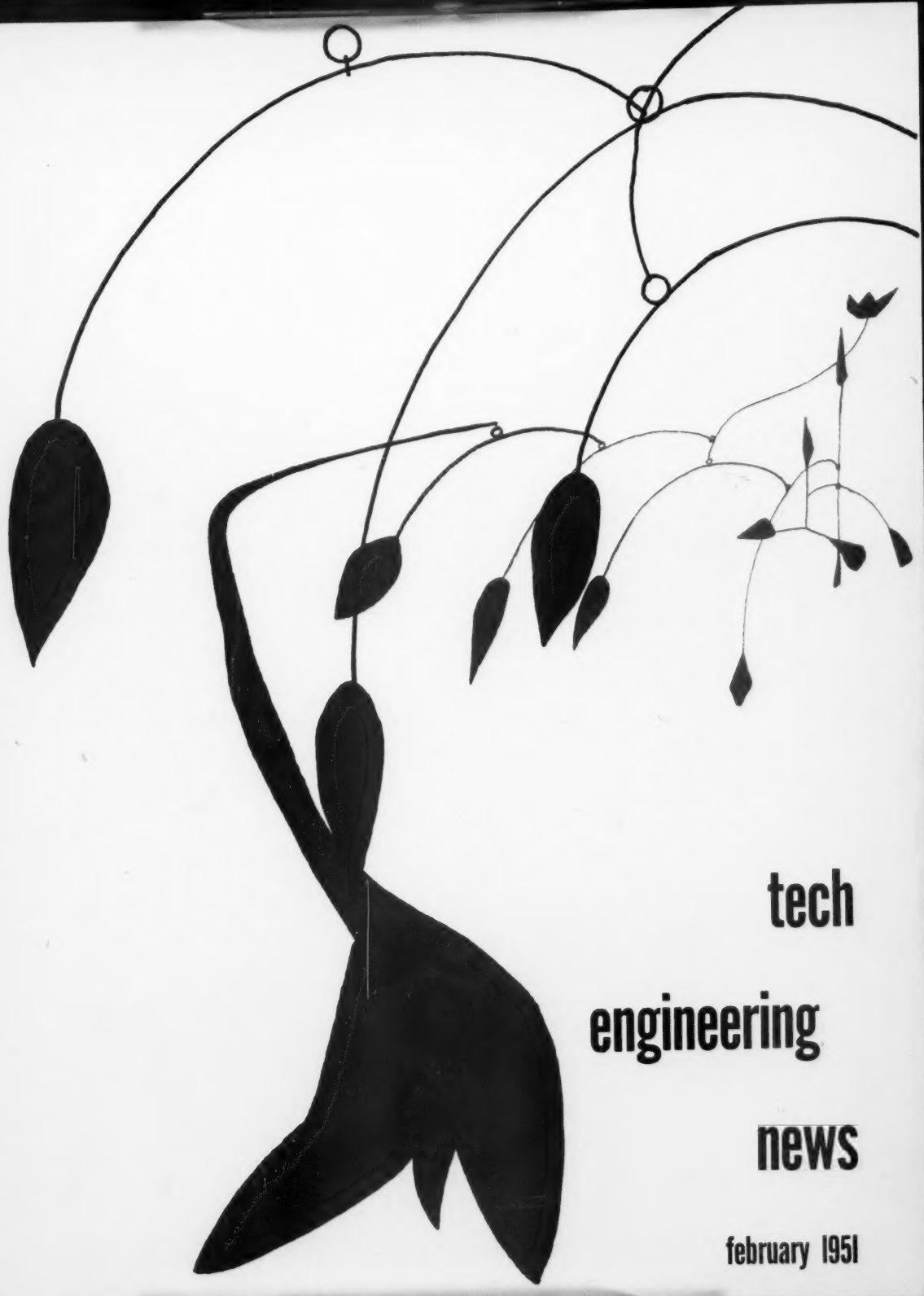
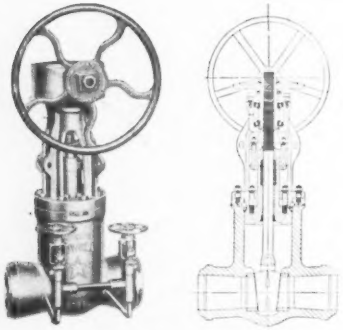


tech engineering news

february 1951

Another page for **YOUR BEARING NOTEBOOK**



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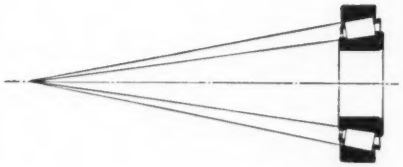

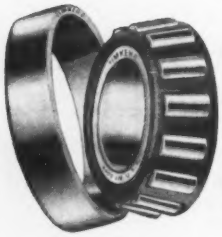

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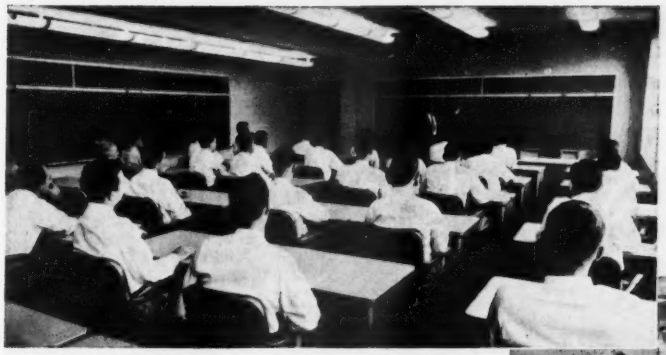
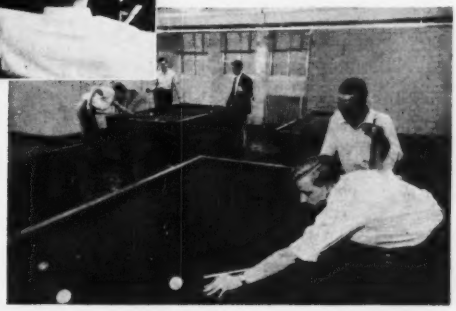
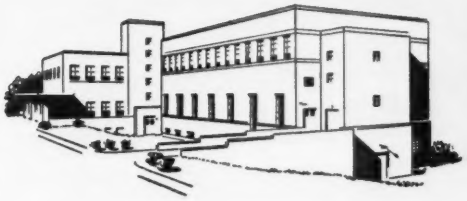


A typical scene in one of the several modern classrooms in the new Educational Center Building.

Below: View of billiard room. Other rooms where hobbies can be pursued and facilities for indoor and outdoor games provide relaxation and set the stage for lifelong friendships.





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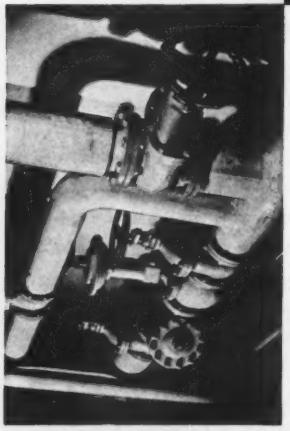

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san saba's lost silver

There's Silver in Them Thar Hills

By John Mathis, '53

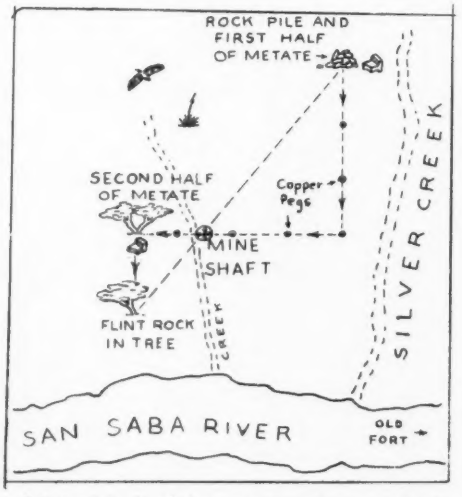
The small, dusty-brown horned toads that sun themselves in the shimmering heat of a southwestern day look out at a land almost unchanged by our modern world's progress. The colorful limestone *mesas* that

project abruptly from the brushy wastelands, the scrubby but hardy mesquite bushes, many decades old but only a few feet high, and the awkward brownish jack rabbits alertly watching for enemies look on man with quiet disdain. Whole areas of the vast lands of West Texas, New Mexico, and Arizona stretch without break to the horizon. Thousands of square miles are ribbed by rugged hills, ridges, cañons, and mountains that conceal far more than they reveal. The few black buzzards that constantly circle back and forth over the mesquite brush look exactly as they did when searching for the dead the earliest Spaniards left behind them.

The early explorers struck out across this desolate country with only one thing in mind — the fabulous deposits of gold and silver that they had heard of "beyond the mountains." They actually saw half-starved Indians wearing silver buckles on their shoes and golden ornaments on their clothes, but they always learned that the gold was "más allá," or "farther on." They kept searching onward until they either had to turn back or ran out of water in the scorching sun. The rough limestone hills, deep cañons, and dusty river beds gradually acquired legends of fabulous riches awaiting discovery by anyone hardy enough to seek for them.

But even as the wealth locked up in the cañons grew on each retelling around the nightly campfires, a few real discoveries of large deposits of gold and silver were made. The Spaniards eventually located several diggings that yielded a great quantity of gold and silver bullion, which was loaded on burros, or small Mexican donkeys, and carried to ports to be shipped to the mother country's waiting treasury. Sometimes these mule trains would be ambushed by hostile Indians or robbers, who in turn would often hide their loot to enable them to make a swift escape. Because of Indians, the rich mines themselves were sometimes sealed thoroughly and then abandoned. Since the Spaniards often dealt with their Mexican or Indian labor according to the long-established rule of the time that "dead men don't talk," the exact location of these mines became a subject of much speculation and endless dreaming by those incurable optimists who came to the area fired with the prospect of becoming rich for life at the next turn of the trail.

One of the most persistent tales in West Texas is that of the Lost San Saba Mine. It is like the will-o'-the-wisp; prospectors' tales of this silver mine place it over an area two hundred miles square. It is constantly changing location and name, but always it just barely eludes the determined army of seekers that is looking "más allá."



Much of the San Saba story is based on actual fact. It is known that in 1756 the lieutenant-governor of the Spanish province of Texas, Don Bernado de Mirando, set out with a small party of soldiers and guides from

what is now San Antonio, Texas. His mission was to investigate rumors of vast silver deposits contained in the hills to the northwest of San Antonio. After eight days' travel, he came to a small reddish hill which had a cave in its side. Don Bernado investigated the cave and found that the rumors were true; he had stumbled onto a rich vein of silver ore. He carefully noted the location, observed that the area seemed suitable for supporting a group of miners and a garrison of troops to protect them, and reported back to San Antonio.

Oddly enough, his report failed to create any wild excitement. Although the three pounds of ore that Don Bernado brought back to San Antonio assayed a good showing of silver, the viceroy of Mexico felt that a larger sampling should have been made. Mirando was ordered to bring in thirty mule loads of ore. He protested violently, but at last agreed to pay for the expense of the assaying himself. Unfortunately, at this crucial stage he was transferred to another mission in East Texas.

Several years later, the Spaniards established a mission at San Luis de la Amarillas, some one hundred and fifty miles from the deposit, to try to convert the wild Apache Indians to Christianity. The commandant of the garrison asked permission to move closer to the diggings so that they could be worked in safety, but the Governor refused. Later the savage Comanches attacked the Spanish settlement and completely wiped it out.

Following the massacre, another mission was established on the same site in spite of another proposal to move it closer to the mine. After twelve years, it also was abandoned. The Spaniards then decided to conceal the rich ore that governmental red tape had prevented them from mining; they dammed a small stream, diverted its bed into the diggings, and covered the entire site with tons of silt. The mine was perfectly hidden from outside observation, but it was certainly not forgotten.

Many searchers soon roamed the area, braving hostile Indians as well as bandits, in an effort to strike the rich diggings. One of the most important of these hardy prospectors was James Bowie, the inventor and chief wielder of the knife that bears his name. Bowie had ridden alligators in Louisiana, carved many an opponent apart in a dark barroom brawl, and smuggled slaves into the United States with the pirate Jean Lafitte. He had also devoted a great deal of his time to roaming about West Texas in search of Spanish gold, and he became interested in the San Saba country. It had been common knowledge for some time that a tribe of Indians, the Lipans, had been trading with silver that had been mined in the San Saba area. Bowie saw that these Indians had discovered the lost Spanish mine, or a similar one, and shrewdly cultivated their friendship. He was finally taken in as a full-fledged member of the tribe. His great hunting ability aided the Lipans greatly, and at last their chief showed him what he had spent months in waiting to see — the San Saba diggings.

Bowie had been expecting to see a great deal, but he was overwhelmed at the vast amount of silver that the Indians showed him. When he saw that he could be rich for life, he immediately deserted his Indian friends and went to enlist aid in San Antonio.

He had no trouble in getting together a group of eager treasure seekers to share his bonanza. The party that he formed numbered eleven, including himself and his brother. On the way to the diggings, however, the party was ambushed by Indians and forced to take shelter in a brush thicket. Although it beat off the attack, the group was then obliged to wait eight days before its wounded members were able to move, and then it returned to San Antonio rather than going ahead to the silver. Bowie never was able to go back to the lode. Some people believe that he carried the secret of the location of the San Saba mine with him to his death in the Alamo. Who can say?

But Bowie wasn't the only person to get temptingly close to the San Saba's riches. A man named Dixon settled in the San Marcos River Valley in West Texas about 1830. He hired an Indian servant who eventually

agreed to show him a cave full of silver. The Indian said that the cave's entrance was covered with rocks, but that he had been inside before and could get in again. Dixon was naturally very enthusiastic and started out with the Indian for the San Saba country.

When the pair reached the area, they found signs of Indian warfare everywhere. The Comanches and Apaches were on the warpath! The Indian didn't dare take Dixon to the exact spot of the hidden treasure, but he did point out the general location of the mine. Dixon etched the picture of that area in his mind and returned to San Marcos to wait for more peaceful times. The Indian died shortly thereafter and Dixon had to rely on his memory.

Back in San Marcos, Dixon took three of his friends into his confidence. Since the Indian had been a practiced and accomplished liar, the four treasure seekers decided to get a little more positive information about

(*Continued on page 20*)

on the origin of continents

The Land Masses Are Still Growing According to One Theory

By Professor Patrick M. Hurley

An earth model widely accepted among geologists is being critically reviewed in the light of new geophysical measurements. It has the following general characteristics. The continents are platforms of light rocks enriched in silica, alumina and alkalis generally referred to as sialic rocks. They "float" in gravitational equilibrium at a mean elevation of 5 km. on a universal layer or shell of crystalline material containing less silica and alkalies, generally referred to as the gabbroic or basaltic layer. This shell is pictured variously as 30 to 70 km. thick, and is underlain either by a vitreous material of the same composition extending to over 400 km. depth or by material dominantly composed of magnesium iron silicates. The latter material extends from the bottom of the above-mentioned shell down to 2900 km., which marks the boundary of the core. The core is believed to be composed dominantly of iron-nickel, in a liquid state. These concepts are based largely on measured velocities and transmission of seismic longitudinal and transverse waves, on the composition and relative abundance of types of meteoritic material that is believed to have come originally from a broken-up planet, on the mean density of the earth and its moment of inertia and ellipticity, and on observed geological phenomena at the surface.

Most hypotheses regarding the early history of the earth, whether it was formed of hot gaseous material drawn from the sun or by accretion from a dust cloud, have the earth entirely liquid at the beginning, largely to explain the gravitational separation of the iron core. This assumption gives rise to discussion regarding the mode of cooling of the silicate "mantle," or that part of the earth between the core and the crust, 2900 km. thick. Presumably a surface layer would cool quickly by radiation and crystallize. Blocks of this now denser material would sink and add to the convective motion normally expected in the sub-surface liquid system. The increase of pressure (about 1.3×10^6 bars at the base of the mantle) would supersede the temperature rise in its effect on crystallization and the mantle would solidify from the base up. This process would tend to separate high-melting-point minerals at lesser depth, but presumably the uniformity of gradation would be disturbed locally by late convective motions. Somehow the main masses of the continents would be formed on the surface at this early time. Continuing volcanism is explained as local melting of the basaltic layer where it is downwarped into a hotter region as a result of convective motions in the mantle or by lateral compression on parts of the crust.

Research in the Geology Department at the Institute is uncovering factors which are not in accord with some of these tenets. Recent measurements of the radioactivity of some of the largest masses of volcanic rock that have flowed to the surface in recent times strongly suggest that this material could not represent a sample of the basaltic layer since the radioactive heat generation is so great as to be incompatible with measurements of the heat flux to the surface of the earth. It looks as if these lavas must be recent concentrations derived by differential melting from large volumes of material in the earth's mantle. This suggests that the mantle is at least locally, if not universally, heating up, and that new material for the growth of continents is available as a result of a fractionation process that extends to probably several hundred kilometers below the surface, and that the process has been going on at all times throughout geologic history.

Measurements of the flow of heat to the surface of the earth vary from 1.0 microcal per cm.^{2} per sec. in flat-lying areas to 1.7 in granitic mountains at high elevation. Thermal gradient at the surface may be as great as 40°C/km. for sedimentary rocks but measurements show a range between 9 and 22°C/km. for "basement" rocks which generally underlie sediments at not great depth. The amount of U, Th and K in granites generate heat at an average figure of about 5.10^{-13} cal./cm.^{3} sec. and this decreases roughly with the decrease in alkalis in rock types, with the purer magnesium-iron silicates being very low. Thus in a general way the rocks near the surface of the earth contain most of the radioactive elements, the amount increasing as the surface is approached.

The most prominent seismic discontinuity near the surface occurs at about 30 km. depth, and the velocity of longitudinal waves above this are generally less than 7.0 km./sec. — velocities which indicate rocks of granitic and intermediate types. The mean heat generation down to this depth therefore should be between 2 and 4×10^{-13} cal./cm.^{3}/sec. The heat contributed to the surface flux by this shallow layer would thus be 60 to 90 per cent of the total flux. Thus the thermal gradient at 30 km. should be reduced to about twenty-five per cent of the surface value and the actual temperature at that depth only about 300°C.

On the Columbia Plateau in Oregon several hundred cubic miles of lava have recently (fifteen million years ago) flowed out of deep cracks in the crust with much fluidity and probable super heat. Their temperature was probably in excess of 1000°C. They contain an average radioelement content that generates 1.5×10^{-13} cal./cm.^{3} sec. Owing to the reduced thermal gradient below 30 km. it looks as if the lavas must have come from a region over 200 km. below the surface in order to have reached 1000C° temperature. If the lavas represent a sample of the gross material at that depth, there would be a much larger heat flow to the surface than actually exists, since the layer above 30 km. already accounts for the bulk of the heat flow. This leaves the alternative that the material coming to the surface is an extract, or concentrate, derived from a large volume in the mantle, and that the segregation process has occurred not too long ago. The idea of a downwarping of a basaltic layer to raise its temperature to 1000°C. is again not permitted since the cover necessary to raise the temperature would itself produce more than any observed surface heat flow; although there is always the possibility that such heat flows have occurred in the past. If it is true that volcanic materials are not merely a local melting of some new surface layer, it means that new material from deep below the crust is

(*Continued on page 22*)

a bloody business

The Story of Donated Blood

By David Sternlight, '54

No doubt many of you have given blood at one time or another during your lifetime, or will give some. You may wonder just what happens to your blood after it leaves your arm; just what is done to it before it becomes the neatly labeled group of products so useful to medical science. At first, after leaving your arm the blood takes

Fig. 1. Interior of the Red Cross Bloodmobile, showing bags containing fresh blood ready to be processed. It is sedimenting at this stage.

one of two different routes. Until a few years ago an older process for collecting blood was in effect, and the blood went from your arm into a bottle containing ACD or Acid Citrate Dextrose solution, which was an anti-coagulant and prevented the clotting of the blood. However, this method had one important drawback. Because of the use of the ACD solution, the white blood cells, important in fighting disease, are killed. The opportunity to study them alive and determine their properties was extremely difficult. Blood from many patients could not be compared to see how different diseases affected the white cells. Now, however, a newer method is in use. The blood leaves your arm, and instead of passing into a bottle, enters an ion-exchange column. This column replaces the calcium in your blood with sodium. This step eliminates the elaborate and annoying proceedings necessary before the invention of this process to prevent the coagulation of blood. When the calcium is removed, the blood cannot clot.

After leaving the ionization column, the blood passes into a plastic bag. Some of these are shown in Figure 1. As the illustration shows, each bag is divided into many sections. In the top section, labeled A in Figure 1, the blood from the ion-exchange column is mixed in a dextrin-dextrose solution. This solution acts to bunch and settle the red blood cells. As soon as the blood enters the bag from your arm, the bags are removed from the donation room and hung on racks, as shown in the photograph. This is to allow the red cells to settle to the bottom of Section A in the bag. The bag is kept in the rack for 1½ hours, after which the red cells, which have already settled to the bottom of Section A, are passed into Section C, which is shown full of blood in bags 1 and 2 in Figure 1. The red cells then settle for another one and one-half hours in Section C. They are finally admitted to Section E, which contains a preservative, while the surplus dextrin-dextrose solution, which was left on top when the red cells settled, is let into Section D.

The plasma, which is the colorless liquid containing all the other blood components after the red cells have been removed, is the liquid which rises to the top of Section A. This is piped into Section B. As you have seen, the blood has merely been separated into plasma and red cells, by sedimentation, after entering the bag. The result is red cells in Section E, fairly uncontaminated

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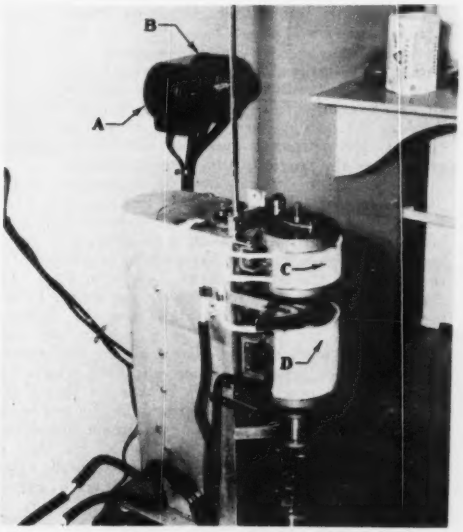
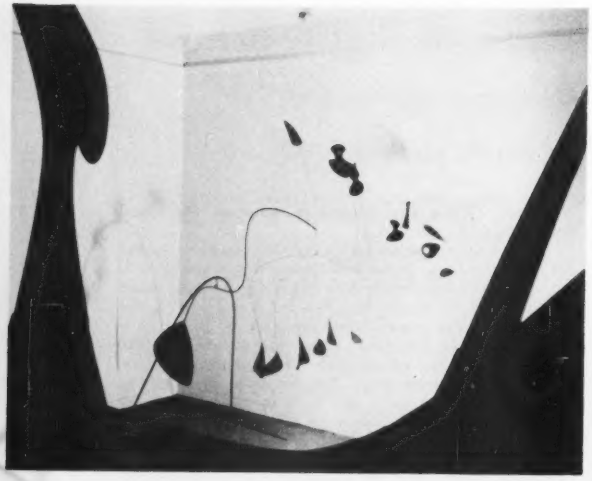


Fig. 2. This is the floating film centrifuge, really two centrifuges in one.

the art

By Bob



Herbert Matter

Contrast from white walls, shadows, and black mobiles and stabiles.

One of the most original contributions to modern art is the sculpture of Alexander Calder. Possibly Mr. Calder would object to having his works called sculpture, for doing so makes him a sculptor; and he does not want to think of himself as just another in his family of sculptors. All his life he has striven to be original and natural. The objects he makes are ample evidence of originality. Only a Calder can make them.

He was born in Philadelphia in 1898. His mother was a painter and both his father and grandfather were sculptors. His grandfather, Alexander Milne Calder, had been fairly well known in his day, especially for his statue of General Meade in Philadelphia's Fairmount Park and his statue of William Penn atop Philadelphia's City Hall which can still be seen for miles around by all who happen to glance toward the center of Philadelphia. In spite of such imposing artistic parentage, young Calder's interests were tools and not the brushes and clay of the studio in which he was raised.

From 1915 to 1919 he studied engineering at the Stevens Institute of Technology in Hoboken and afterwards spent several years over an industrial drawing board until something awakened an interest in art in him. He quickly dropped his drafting and enrolled in the School of the Art Students' League in 1923. On the side he did art work for whoever was willing to hire him. His most consistent patron was the *National Police Gazette* for whom he did a regular half page spread. His work was not distinguished but showed signs of a keen sense of humor, a quality which was later to mean much to him. It was for this *Police Gazette* that he first covered a circus. Of the two weeks allotted for the job, he spent one afternoon completing his assignment and devoted the rest of his time to studying and sketching the circus. A small book called *Animal Sketches* later appeared, but this circus experience was to go much further than that.

The urge to visit gay Paris, the reputed home of the artists of the world, overcame him, and he signed on a freighter for Europe in 1926. When he arrived in Paris, he was poor and just about devoid of any acquaintances. A few fellow art students he had known at the League were his only friends.

His circus memories prompted him to construct some small animals and acrobats with which he loved to play. The ingenuity of them amazed and charmed his friends who always insisted on seeing them, and they urged him to make more. This business grew and grew until he found that he had a sizable miniature circus on his hands that was giving performances in his room to large crowds. This is hardly an exaggeration, for the Paris press carried notes on it and praised the skill and wit of the creator. All the gentry of Paris, including the artists, flocked to see it. These miniatures were certainly original everyone agreed, and they were almost human in that they were unpredictable. Often as Calder conducted his circus performance his acrobats would slip — sometimes they fell into the net stretched out below and sometimes they grabbed hold of something else with a protruding foot or arm. This natural element of imperfection fascinated his guests.

Assembling the M. I. T. exhibition. *Elliot Saltzman*

In constructing his miniature circus, Calder had employed the first of his original creations — wire sculptures. These three-dimensional wire sculptures have been described as "peelings of form without weight or density" in which space intervenes as a constructive factor. They are merely wires that have been twisted into a three-dimensional figure.

In 1928 Calder returned to New York for his first one-man exhibition which was a display of wire sculptures of many well-known public figures of the day. The only objection to this new art was raised by one of the few critics he loved — his father — who felt that,

# of calder

Donovan, '52

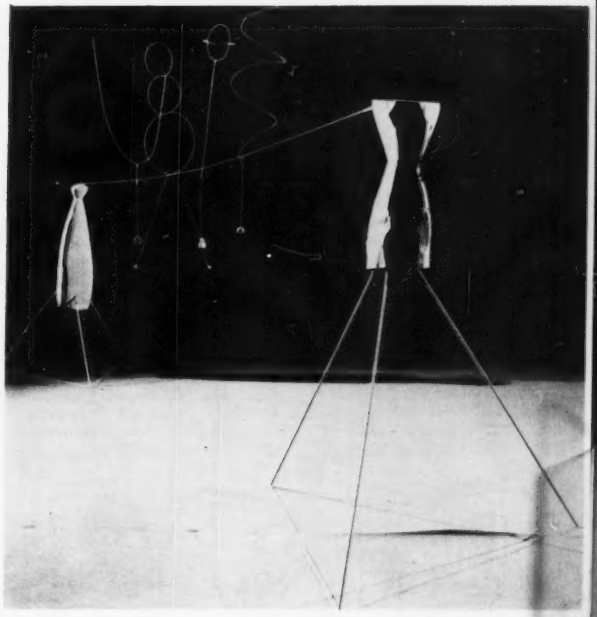
while artistically they were good and indeed quite witty, they did definitely lack an appeal to the sense of touch. Notwithstanding this Calder gained considerable fame from this exhibition, principally as a humorist. He returned to Paris satisfied.

His next step was to begin work on the problem of incorporating motion into his sculpture, since he felt that movement is certainly natural. He made a wire sculpture of a fish bowl in which the fish were driven about as though swimming by an electric motor. This was a good beginning he felt but still left much to be desired.

About this time he was invited to the studios of the famous Piet Mondrain. He was amazed and inspired by what he saw. The walls of the studio were painted in rectangles of red, yellow, and blue; and Mondrain's paintings seemed to flicker and flash. The idea of motion was everywhere, and yet everything remained stationary. Calder decided that something should move, but Mondrain would not hear of it.

The effects of his friendship with Mondrain were quite evident in his Paris exhibition of 1931. This exhibition included his first abstract constructions of "volumes, vectors, and densities," as he called his objects or stabiles as they were later named. These stabiles were simply colored rectangles and other geometric shapes assembled in such a fashion as to be the work of an artist. This exhibition was a big step for Calder, for previously he had been known as a humorist, a circus man, talented and witty, and now he appeared as a serious constructionist. The art world accepted him — not as a newly discovered genius but as a man with signs of great possibilities.

"The Whale" — a stabile. *Herbert Matter*



Herbert Matter

"Tight Rope Walkers" — a wire sculpture.

Again he began work on the idea of incorporating motion. The modern world is a world of motion and therefore the "volumes, vectors, and densities" must vibrate and oscillate. He concluded that to combine two or more simple movements with contrasting rates of speed would give the best effects because, while simple, they are capable of infinite combinations. These moving stabiles were named mobiles quite logically.

Most of his early mobiles were motor driven and this, of course, meant a set pattern. He found this condition constraining. Unpredictability of movement would give a much truer sense of life; and with this in mind Calder did away with his motors as much as possible. Since 1934 he has made wind driven mobiles almost exclusively.

Another well-known French artist, Joan Miro, influenced the development of free form in Calder. By abandoning the geometrical rectangles and circles he had been using and adapting the random patterns of free form, he felt he was creating a much more natural form. He still strives to cut his objects in such a fashion that they appear never to have been touched by tools. This conscious avoidance of technical finish to give the natural idea of imperfection was not new with Calder; he had discovered the beauty of that quality with his miniature circus acrobats.

Calder's shop is now located in the countryside of Connecticut where he cuts and creates his mobiles for exhibitions and for sale. Recently he has been invited

(*Continued on page 26*)

impressions of the u. s. a.

An Appraisal of the United States by Some of Tech's Foreign Students

By the T. E. N. Staff

We Americans usually take life in the United States for granted, for it is all we have ever known. Not so with the many foreign students who come to study at the Institute from all over the globe. Their cultural backgrounds present quite a contrast with ours and consequently their opinion of life in the U. S. A. is oftimes quite different from ours. The *Tech Engineering News*, in an attempt to discover some new or interesting ideas on the subject, has asked a number of foreign

students around the Institute to write about their impressions of the United States.

A student from Brazil writes this:

"My first impression when I left the ship at New York harbor was that it was colder than any weather I had been in for many years. This American weather is too much for me, and they even tell me that it is still getting colder now.

"Another of the things that impressed me most was that everything here is done automatically — you eat in an automat, you get chewing gum by sticking a nickel into a machine. You can also get your shoes shined automatically, and a thousand other things are done solely by inserting a coin into a machine. They should discover one that does your quizzes for you too.

"Altogether I am very favorably impressed and I like to live in the United States of America very much."

A neighbor of his from Argentina talks of the unconventional American spirit:

"I think I should be glad to be in New England; it is a kind of compromise between the old Europe and the new Argentina. It seems to me that when the settlers came here they tried to keep it European, just as the settlers in South America. The latter, though, had a big disadvantage in nature, and had to lead an entirely new way of life.

"I believe that Americans are happier than most other people. At the moment they are on the top of their half of the world, and that, of course, is a great aid to this happiness. What I like about them is that they do not stick so much to convention as Europeans or Latin-Americans. They care little about what others do, and when they are in the city, they will not stare at a person who does not have a tie.

"In general Americans think they know other peoples well, but they actually have as many misconceptions about others as the others have about them."

This spirit also impressed a native of Uruguay who says:

"What struck me most on arriving in the U. S. A. was the open, informal nature of the majority of the people. In practically all the contacts I have had with Americans they have shown an extremely friendly and helpful spirit. They always seem to go out of their way to try to be of assistance to their fellow man, especially when they realize that they are dealing with a person who is unfamiliar with their customs and not completely at ease with their language.

"I am, therefore, very grateful to have encountered this characteristic behavior which has made my first weeks in the United States of America much easier."

Another South American is impressed by our standard of living and our many small conveniences that make life "easier":

"I believe that it is in the little things in life that the American is least conscious of how different his country is. Americans take for granted the air-conditioning of their movie theatres which is often more pleasing than the movie itself. They live naturally with their monumental Sunday newspapers, their fantastic drug emporiums which sell everything from hardware to dry goods, the multitude of secretaries who block off telephone calls from the one person they want to talk with, and the dreadful iced water which paralyzes digestion at every meal.

"Yet, the iced water, like every dismal feature of American life, has its cheering effects. When it runs out of the hotel faucet instantly, it is a miracle no less. I think that it is wonderful how practical things work in America. Doors, even incredible thick glass doors, open and close efficiently; radios work; and so do

automobiles and refrigerators. You say, "of course," but you do not know what a nuisance the mechanical things of Europe often are.

"Yet, with their mechanical ability, Americans permit themselves and their horrified guests to suffer perpetually from the electric shocks which leap at you in the winter from doorknobs and light switches. They use the absurdly impractical English yard and ounce, until they deal with the dollar when practicality and the decimal system return with a rush.

"At parties in America I meet scores of fascinating people and I never see any of them again. They say to me, 'Be sure to look me up,' or 'I hope to see you soon,' but what that means is 'I don't think we will ever meet again.'

"At these parties I hear some of the adults fretting over Russia and the standardization of life in Russia. Standardization? Americans listen to the same radio, look at the same movies, read the same syndicated columnists, use the same gasoline in the same cars. Going to San Francisco I have eaten the same sandwiches and sausages the whole trip."

The American boy-girl relationship differs considerably from that of Cuba and a Cuban student has these comments to make:

"In Cuba, a large tropical island which, I am sure, all of you have heard about, we do not have what is called here a 'date.' When a boy and a girl want to go out they are almost always accompanied by the mother or some other close relative of the girl. Here in these wonderful democratic United States of America, things are quite different — a boy just makes a date with a girl and he is all set, and I truly mean all set. As a consequence, I naturally prefer the American system of dating.

"Another difference which I wish to point out about the American and Cuban youth is the way they treat each other. In Cuba, if you are the boy friend of a girl, that girl will go out to the dances and the movies with you alone, and you really feel as if she 'belongs' to you. Here in the States the girls consider themselves free of these requirements and they usually go out every week with a different boy. In this relationship between boys and girls I prefer the system we have in Cuba."

An Italian has some light to shed on the origin of some of the myths about fabulous America which are so widespread in Europe:

" 'M. I. T.? Don't be insane! You realize you'll have to study fifteen hours a day? Thirty per cent of the freshman class flunks out before the end of the first term! You ever hear about "charrettes" at architecture schools? Tech is just one long charrette — heaven for benzadrine peddlers. Repent, kid — save yourself before it's too late!' That's the advice given to foreigners.

"It's not really as bad as all that. Why do people tend to exaggerate anything American, especially when talking to Europeans? It's really very difficult for us Europeans to formulate correct opinions of a country where presumably everything comes in cans; where money grows on trees; where the population is continually battling cowboys or Chicago gangsters; where ninety-nine per cent of the people are divorced at least twice before they are thirty. Difficult? It's quite impossible.

"Strangely enough, even though Americans tend to all be Texans when they travel abroad, it is not so much the Americans as the Europeans who have been in the United States that so often exaggerate and spread misconceptions.

"I was traveling on a train to Venice. Across from me in the compartment sat a sailor. Next to him sat a man who listened very attentively as the sailor described his fifteen years of navigation.

" 'New York! There's a town. Never seen anything like it on Saturday nights. Nothing but beautiful women all dressed in beautiful long evening gowns. You know what they do? They ride the trolley cars — all so jam-packed that some of them are hanging on the outside — and holler at the top of their lungs. Yell, sing, make a helluva lot of noise. And do you know

(*Continued on page 34*)

science, man and music

The Effect of the Modern World on Music

By Peter D. Paul, '54

Music in a material world: it puzzles. Music has no material value; that it should flourish would seem a grave idiosyncrasy. The factory builds, and we touch its product. Music lingers so short a while, and then is gone, leaving but a ghost of a melody, or a vile taste. Still it is; and takes its place in the world of machines, with the machines. Unscientific, not explained, theory built on indistinct substance, but natural and reflective: that is music.

Years passed, and centuries, until time became a dimension; time, the dimension of change. The globe shrank, and grew heavy with cities and more people. Still wars were waged, and violent revolutions said that the "people" would speak, speak with voices of barking demagogues. The world would have knowledge, so science grew and swelled to new size. Science built the machines. Came the engineer; he fed the machines whims of men, and they produced material reality.

There was the musician too. He saw the machines, and saw science, and the civilization that existed in the world of science and technology. His mind fed on Darwin and Freud; he ate hybrid corn and wheat; he lived with the radio and airplane and used them. The twentieth century he assimilated became a part of him. And when he wrote his music, he expressed himself as a part of his time; he wrote science into every score.

Notice rhythm. Recurrence and variation. Recurrence. Beating irregularity. Regularity. Dripping rain; shuttling freight cars, steel on steel; and the pulsating machines that drone on endlessly, like the ticking of the clock as time passes. Make time the structure on which to hang life and change; or a throbbing machine the source of a prosperous society; there still is rhythm. Music is based on rhythm, and built on its natural base. Its dimensions are time, and its tense is present.

This is the twentieth century whose ideals reacted against those of the past. Science fought speculation, and men followed the paths of science. Philosophy was built on Darwin; literature tried to achieve realism; and art broke entirely from the absolute and assumed originality as its standard and goal. Musicians, too, became iconoclasts. Science that crushed the inelastic patterns of traditions set an example for musicians to follow. They proceeded to break the accepted rules of music, and with good success.

But music was slow to follow science; the machines had first to act on society and its individual members, among them the musicians. Then came the break with the sentimental realm of the nineteenth century Romanticist music; for the twentieth century composer's background led him to see a multi-faceted world in realism. There were people and institutions that could be written about, methods and themes, once thought too insignificant, that could produce a good music.

The realm of music expanded rapidly, as science probed into all walks of life, as the working class rose in importance as a result of mechanization, and as technology found new sectors of the earth's surface, and new segments of its population.

Composers were at liberty to follow what methods they chose. Many experimented to find new methods of expression. The past fifty years have been marked by experiments with both new techniques and past ones. Some chose to exploit jazz, while others returned to the Classicist and Baroque periods for their inspiration. Later composers put form and technique subservient to expression.

At the beginning of the century Arnold Schoenberg developed a revolutionary style of writing music. His music was built with dissonant chords — those unresolved and not pleasant to hear — as well as consonant, or pleasing, chords. This method, atonality as it is called, is the indirect expression of a more realistic society that recognizes the unpleasant and tries to understand it. It follows after a science that experiments to find the new and useful, a science that realizes the brutal.

The use of dissonance opened a new vocabulary for music. Dissonance, once strictly forbidden, produced a contrast with the widely used consonance. With unresolved sounds new effects might be accomplished. Audiences have not accepted dissonant music readily. While it can be successful when skillfully applied, dissonance, poorly used, can produce the most tedious and grinding sort of music. When Alban Berg's *Wozzeck* was performed in Paris this winter, one critic remarked that the composer had produced a brilliant score, but set a poor example.

Darius Milhaud has been among the protagonists of another major innovation in musical technique:polytonic harmony — which merely involves simultaneous playing of two or more chords in different keys. This is the work of many experimenters, rather than one man, offered as another possible means of making music more colorful and diversified. Bach, the most notable experimenter of his time, touched polytonic music two centuries ago, when he had two instruments play simultaneously in different keys.

George Gershwin worked to bring jazz into the realm of serious music. After his earlier work with popular music, he successfully applied jazz idioms and produced such well-known works as *An American in Paris*, and *Rhapsody in Blue*.

Many have turned back to older forms of the classical and baroque periods. Prokofieff has applied modern methods to classical forms, to attain a lyric quality in his works. Hindemith has written chamber music in strictly modern style, along historical lines of form.

American music which long failed to find any sort of serious outlet managed during the twentieth century to attain a prominence equal to that of other countries which were long considered centers of music. It tried so long to impersonate the music of the continent without success. Perhaps the Bohemian composer Anton Dvorak did the most to open American eyes to native musical possibilities when he wrote his immortal *Symphony From the New World*, on solidly American themes.

Americans led by such men as Aaron Copland and

(*Continued on page 36*)

you can't win

Perfection in Tic-tac-toe

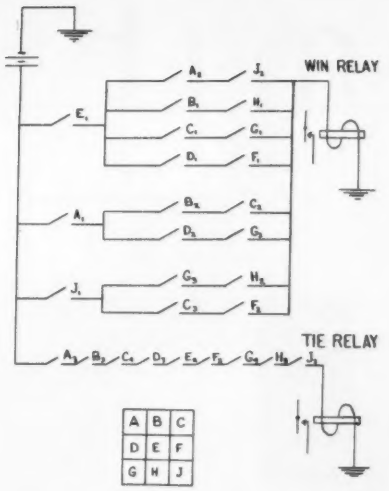
By Robert Redick, '53

Watching something being done extremely well, if not almost perfectly, has been a fascinating source of entertainment since way back when — everything from juggling acts to professional baseball. So, when a machine that could play tic-tac-toe better than any of the students made its appearance here at Tech, it is not surprising that it attracted quite a lot of interest. Many people so far have played against this machine; some tieing, most of them losing, and none winning. The machine is incapable of losing at tic-tac-toe. Locked within its "mind" is a perfect reply to any and every move made by an opponent.

Built by a graduate student, Dave Crocker, and his confederates, in the short space of two days, this machine has been the source of many questions.

Machine psychology is the first factor to be taken into consideration. Such an abstract idea, for instance, as "three-in-a-row" cannot directly be built into a system of relays. The machine has no concept of space. Consequently it is necessary to resolve tic-tac-toe into a game of possible sequences. Lettering the nine squares in a tic-tac-toe block A through J, it is seen that there are eight possible combinations for winning, a tie occurring when the block is filled without either the player or the machine having attained any one of those combinations. From the mechanical standpoint, there are eighteen lights, two in each square, which indicate the plays that have been made. There are correspondingly eighteen relays actuating these lights which can likewise be designated A through J according to which square they are associated with. There are now two relays for each square, so to further distinguish them, let those relays which react to a move by the player be designated by a prime letter; i.e. B′, J′, etc. Further complicating the situation, there are two more lights which indicate whether the machine has tied or won the game. The relays actuating these lights shall be called the *tie relay* and the *win relay*. The analysis of the machine is now reduced to a problem of determining how these relays should be wired so that the desired responses are obtained. The complexity of this wiring, however, is so great that the common circuit diagram loses its usefulness and another approach must be made. There are undoubtedly a number of possible choices, but since it seems to be in vogue here at Tech, the mathematical approach will be used.

As there are probably very few who are familiar with *Boolean Algebra*, a brief explanation of its application to this particular problem is necessary. First a normally open circuit is chosen which is to be closed under certain predetermined conditions. These conditions are the state of, either actuated or unactuated, some number of specific relays. Remembering the relays have been designated by letters, let the product of any number of these letters mean that all of those relays must be actuated before the circuit becomes closed. In other words, a product means *and*. A *times* B means A *and* B. Moreover, let a sum mean *or*. A *plus* B represents A *or* B. With these few principles in mind, it is possible to approach the circuit necessary for actuating the *win relay* comparatively effectively. Only the relays controlled by the machine, A through J (not prime), need be taken into consideration, for as



has already been pointed out, the machine's opponent can never win. The necessary condition that must be fulfilled is that the *win relay* must be activated whenever one of the eight possible winning combinations of relays has been actuated. Either A, B, and C must be actuated or A, D, and G, and so on. Mathematically:

$$ABC + DEF + GHJ + ADG + BEH + CFJ + HEJ + CEG$$
$$E(DF + BH + AJ + CG) + A(BC + DG) + J(GH + CF)$$

It will be noticed that the original mathematical formulation was factored, thereby simplifying the corresponding circuit as much as possible, something that would be very difficult without using a mathematical notation. This *win relay* circuit is shown in the accompanying diagram, the inspection of which will make clear how the mathematical formulation was interpreted. The *tie relay* circuit is also shown, but for the sake of simplicity, only diagrammatically. Actually each of the nine relays is paralleled with the corresponding prime relay:

$$(A + A')(B + B')(C + C')(D + D')\ldots.$$

It is interesting now to note certain functional singularities of the machine. Admittedly it would be possible to construct it completely from multi-contact relays. The response would then be more or less direct and the machine would have a faculty which the human mind does not: that of "thinking" of a number of things at once. For reasons that are evident upon circuit analysis, however, it is vastly simpler to have the machine take each factor into consideration singularly and consecutively. The stepping relay used to accomplish this closes one circuit after another, while the machine "contemplates" at each step what move it should make. The machine first looks at each of the eight possible winning combinations to see if it can make a winning move. If it cannot, it determines whether or not there is a necessity for preventing its opponent from winning on the next move. If this is not the case, the machine will then make a move determined by its built-in responses.

In evaluating this tic-tac-toe machine, it is realized that perfection has not only been approached, but reached. There has already been built a machine which plays gin rummy. The only thing left to do will be to build machines to play the machines.

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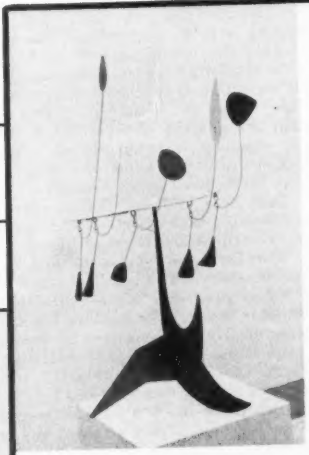

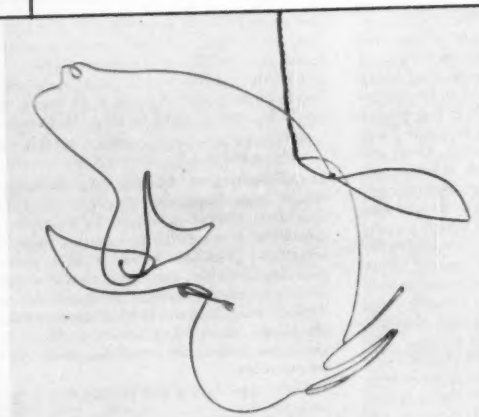

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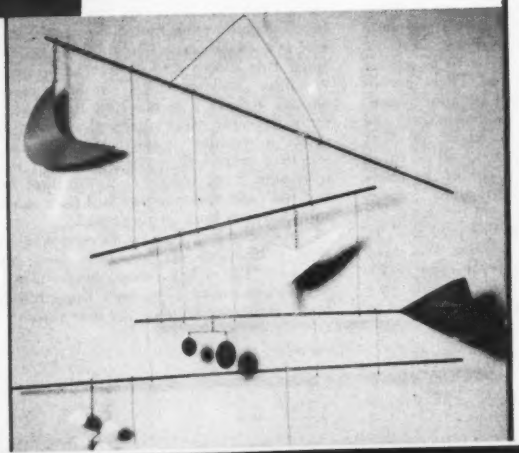

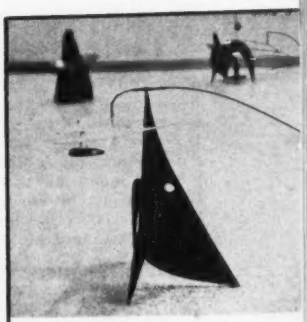

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from the editor's notebook

Are M. I. T. course schedules planned, or do they just grow like Topsy?

There are two or three examples which seem to point to the latter. Last year Course VIII sophomores took 5.11, Qualitative Analysis, and juniors in that course took M37, Advanced Calculus. Now Qual never has seemed to be fun for anyone but the most chemical of chemists, so it was becoming the habit of the physics boys to escape the drudgery of 5.11 by substituting 5.63T, Physical Chemistry, which was more up their alley. This year, the schedule was officially changed, a new course in Physical Chemistry, 5.60, replacing the 5.11. As for the M37, the eager physicists were quick to discover the superiority of Hildebrand's increasingly popular M351 and M352, so many took those in place of the one term M37. As a result, the popular mass movement was made official by this year's catalogue, which requires the M351 and M352 in place of the M37.

According to Professor C. E. Tucker, Chairman of the Undergraduate Courses Committee, the freshman and sophomore years are decided by faculty vote, except for the few professional subjects introduced in the sophomore year; these are introduced by the separate departments, subject to faculty approval. The junior and senior year course curricula are decided by the departments; changes are submitted to Tucker's committee, and by this group to the faculty for a vote. In other words, schedules evolve in the departments, and it is the duty of the committee only to see that proposed changes are in accord with former faculty votes concerning distribution of subjects among the courses.

Now here's the rub. Indeed the above examples show that schedules are being changed, at least within the limits of questionable faculty regulations now on the books. But notice that in each case, the change has been on the initiative of the students. They saw an improvement and went after it. At first sight this circumstance appears to be a happy one — students can exercise their own judgment in choosing what they want to learn. I claim that this is wrong; that students as a rule do not have the best judgment concerning their scholastic needs.

The present system, which relies on student feeling to initiate changes, betrays a weakness in departmental curriculum committees. They don't know what direction to take, so they are forced to listen to public opinion to look as if they are doing anything at all. This is not the way to run this school!

The remedy? Just to realize that at present, teaching and departmental administration are in the hands of men trained as engineers and scientists. Very possibly such men are not the ones to decide undergraduate curricula. Such decisions require men trained in education, men who are devoted to finding what should be taught, how to teach it and when. The lack of such personnel in the departments is a serious one, and to it can be traced many of the absurd and time-wasting requirements of present course schedules. Leaving the problem in student hands is not a solution.

G. B. F.

About Our Authors...

Peter Paul likes and knows music. A freshman, he had to revise his earlier version of "Man, Science, and Music" to make it intelligible to non-musicians. **Dave Sternlight** is also a freshman. He works hard for WMIT, but found time to buttonhole the Bloodmobile workers when they were here last year. The Staff article, "Impressions of the U. S. A.," is really to be credited to our super-ambitious salesman, **Nereo Agostinelli.** A freshman, he undertook to contact and prod into action a large group of foreign students. He comes from Italy. **Bob Redick** is again sounding off on his favorite subject — electrical brains, of one kind and another. Bob is a sophomore. **John Mathis** is a real veteran now; this story is his third this year — we have explored volcanoes and metal spinning factories with him before. **Professor Hurley** did us a real favor to tell about continents; his writing talents are in professional demand. **Bob Donovan,** our literary associate, was in charge of the issue.

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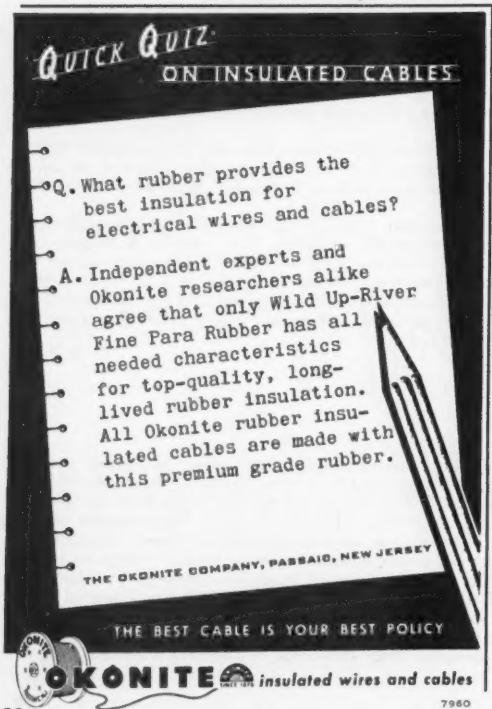
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ON INSULATED CABLES
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san saba's lost silver

(*Continued from page 7*)

the silver. They guessed that the archives of the priests in Monclava, Mexico, which was once the capital of the Mexican provinces of Coahuila and Texas, would contain the old Spanish records of the mine. Dixon promptly went to Monclava on the partners' combined funds and tried every means he could to get the mission's carefully guarded records. He was unable to accomplish anything and was ready to leave when he met a Spaniard whose daughter held a minor post in keeping the secret archives. He told them frankly of his plight, and to his delight the girl readily agreed to find out what she could. She warned Dixon that her search would be slow, for discovery of her spying would mean death to her. Dixon returned to Texas well prepared to wait for the silver that he was sure he would get.

Months came and passed with no word from Monclava. Ten years went by, and Dixon had almost despaired of ever hearing from his Spanish friend. One day, however, he received a letter from the girl saying that she had found information that was too valuable to be trusted to the mails. She asked Dixon to come to see her in San Antonio. He went to her as fast as horse could carry him and found her very willing to give out some information but extremely evasive about much of her findings.

She said that she had found mention of no less than fourteen mines in the vicinity of the San Saba. She would give Dixon a map showing the location of only the richest, where she said that fifty tons of pure silver blocks were stored. In return she demanded one-fifth of the silver; it was also understood that the workings of the first mine would go towards financing the reestablishment of the others. She said that charts to the other thirteen were forthcoming when the silver in the first was found.

Armed with the chart, the partners immediately began to equip themselves for the search. Unfortunately, mining and treasure hunting expeditions require considerable equipment, and the four partners were very short of cash. They gathered equipment for a full two years, and then the Civil War completely disrupted their plans. They all returned from the fighting unharmed, but by the time their expedition was well supplied, complete with a large amount of corn whiskey, ten years had elapsed since they received the chart.

They readily found an old fort on the San Saba that was mentioned in the chart. They went up the river three leagues from the fort and found the prescribed creek emptying into the river. There they found a pile of stones marked on the chart and underneath the pile one-half of an old *metate*, or grinding stone for corn. They knew that they were within a few hundred yards of at least fifty tons of pure silver!

Aflame with excitement, they eagerly ran a line directly south from the rock pile and found small copper

(*Continued on page 22*)

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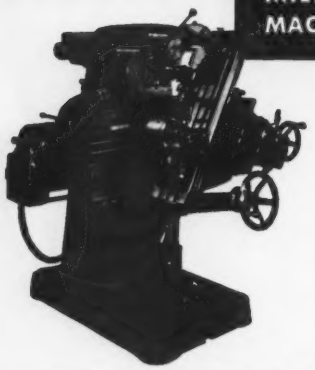

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on the origin of continents

(*Continued from page 8*)

being added as a contribution to the magnitude of the continents and it would be expected therefore that the continents have grown in size throughout geologic history, instead of having been inherited largely from the time of the early cooling processes in the mantle. This means also that material is brought to the surface that would add to the volume of the oceans, and account for the continuing contribution of sodium to the oceans without apparent decrease of this element in the younger igneous rocks of the continents.

A further evidence of the growth of the continental areas is being given by age measurements on the "basement" rocks of the continents. These age measurements are made by measuring the decay-products of radioactive disintegration, such as helium and lead from the uranium and thorium series and Sr^{87} from Rb^{87} in minerals and rocks which contain measurable amounts of the parent elements. The best estimate of the age of the earth based on the ratio of lead isotopes in lead minerals of various ages gives a figure of a little over three billion years. The oldest area so far found is in central Ontario and eastern Manitoba and is about twenty-one hundred million years old, or about two-thirds back in time toward the origin of the earth itself. Other patches show ages all the way down to the present, and it is significant that in the younger areas no old rocks can be found. Thus it seems as if the continent has grown throughout time, in fact the most recent additions appear to be disproportionately large, so that there may even be an acceleration of the process.

san saba's lost silver

(*Continued from page 20*)

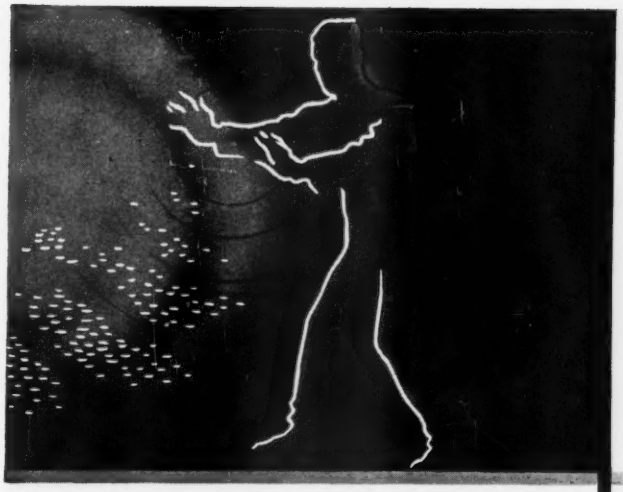
pegs driven into the ground at exactly the prescribed interval of about thirty yards. After three such pegs, they were to turn west, find three more pegs, and sight down the line to two twin mesquite trees. The pegs and tree stumps were exactly where they should have been, and some digging around the tree produced the second half of the *metate* with the completed Spanish word "Excavad," or "Dig," carved on it.

South of the second half of the *metate* they were to find a forked tree with a piece of flint rock in its crotch. They chopped down a few of the scraggly trees and found the rock deeply imbedded in one. Now they had only to sight from the flint rock to the first half of the *metate*. Where that diagonal line crossed the line of the copper pegs was the spot where the silver was buried. Sighting down the line feverishly, they decided that the location of the shaft was almost in the dry bed of a small creek.

The chart indicated that they were separated from a twisting tunnel leading directly to the silver by sixty feet of rock-filled shaft. They attacked the shaft eagerly, but soon the back-breaking labor of lifting the tons of rock out of it discouraged most of the party. The corn whiskey began to flow more freely, and before too long there was a considerable faction of discontented grumblers. Furthermore, the four leaders saw that they would never get to the bullion without expensive rock-lifting machinery. Discouraged and disgusted, the party finally gave up and went back to San Marcos, never to return.

The story of Dixon's tantalizingly close approach to those tons of silver spread, and about 1900 W. M. Longworth heard it and decided to go after the booty. He first wanted to see the archives that the Spanish girl had refused to let Dixon have, so he went to Monclavo and put five hundred dollars in the proper palm. He came out with a long document telling of the fourteen mines and cache of silver. The location given was exactly the same used by Dixon, and the path to the silver through the branching tunnels at the bottom of the shaft was given. Positive that he was but a few short feet from a fortune, he attacked the shaft with gusto, and after a few months of work cleaned it out. Now only the twisting passage remained. The diggers had not cleaned out much of the passage, however, before they struck a large stream of water. Longsworth spent his last funds for a pump, but the flow was too powerful for it. He managed to interest a lawyer in the project and bought a bigger pump. As the directions to the silver became more ambiguous, the mine became honeycombed with shafts. Silver Creek also flooded and refilled the shaft with silt. Down again through the tons of silt and rocks, and back to the problem of the underground floods! The years dragged on, and in 1930 the silver was still as remote as ever. But the thought of the fortunes buried right at their fingertips kept spurring them on.

And who can blame them? The cowpunchers' tales of gold, silver, and jewels hidden just around the next bend of the trail, nestled in the next cañon, or buried under the next mesquite tree set fire to one's imagination. Are these tales true? Ask the Mexican ranch hands, they smile, shrug their shoulders expressively, and say, "¿Quien sabe?" Who knows?



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bloody business

(*Continued from page 9*)

by other components, and the other components of your blood are in Section B. This is called plasma.

Section B is now removed, and taken to a falling film centrifuge. This is shown in Figure 2. It is different from the regular centrifuge in that the blood is centrifuged at two speeds, and in two centrifuges. The top centrifuge separates one component, and the blood, as a film against the wall of the centrifuge, falls down the walls to a lower centrifuge, where the process is repeated to remove another component.

Now for the gory details of the centrifuge. All nonchemists may leave unless they have an unbeatable desire to know what happens in a centrifuge when part of you is spun at 3200 rpm and up. The first centrifuging, in Section C of the centrifuge shown in Figure 2, is at a fairly low speed, to remove the white cells, which I have already mentioned at the beginning of this article. These adhere to the wall of the top centrifuge, and the rest of the plasma passes into the lower section, as a falling film. In the lower section, which is traveling at a higher speed, the platelets are removed. These platelets are still being experimented with, because science is still not quite sure what their purpose is.

After these two centrifugings, the plasma is left with miscellaneous proteins. These are removed in a further centrifuging process. But first I will describe the method used to remove the platelets and white cells from the walls of the centrifuge. The two variable resistors in Figure 2 which are labeled A and B, are used to control the speed of the centrifuges C and D. The white cells are the cells that fight disease germs by preventing their spread. This is done by restricting the focus of infection. These white cells are adhering to the walls of centrifuge C as they centrifuge out from the plasma. They are removed by pouring albumen solution through the centrifuge, simultaneously stopping the top section, C. The white cells are forced into the solution because of their high rotational speed, when the centrifuge is stopped. The platelets are removed in the same manner from the lower section, Section D, except that a saline (salt) solution is used instead of albumen.

After this double centrifuging, the plasma contains only proteins, including antibodies and hormones. These are removed by multiple centrifugation. The plasma goes to a refrigerated tank, where it is mixed with a reagent, filtered, and forced into a centrifuge (the tank-like structures upright in Figure 3) which removes a fraction of the components. The exact substances removed are determined by the reagents used. After the first fraction is removed, the resultant liquid again passes into another tank and is mixed with another reagent, forced into another centrifuge, and

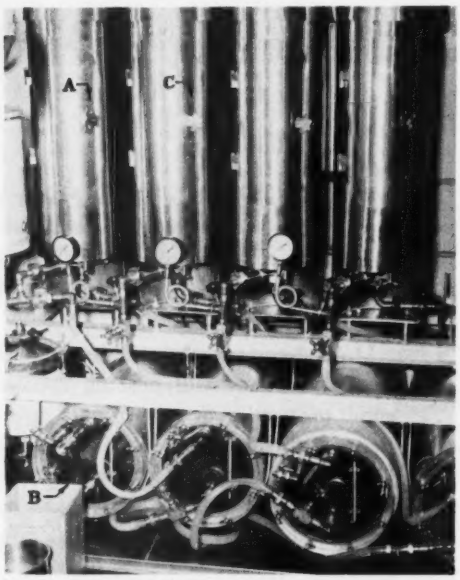

Fig. 3. More centrifuges.

so on. The centrifuges are labeled A, C, and the tanks labeled B, D, etc., in Figure 3. Among the fractions removed are the immune globulins, which produce disease immunity, the blood typing globulins, which determine what your blood type is. This is very interesting because in a transfusion, if you are not given the right blood type, the other cells will attack your own and kill you. Also removed are the hormones, digestive enzymes, and other trace components. The red cells, which are the oxygen carriers, when mixed with the typing globulins, make an excellent blood substitute in cases of anemia.

The big advantage of the Red Cross truck is that the enzymes can be separated immediately, and the proteins are not altered. This simplifies the job of classifying blood, and also makes much more live material available.

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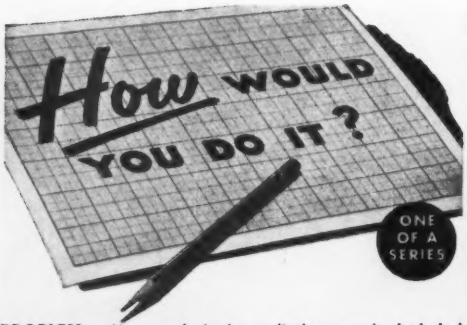

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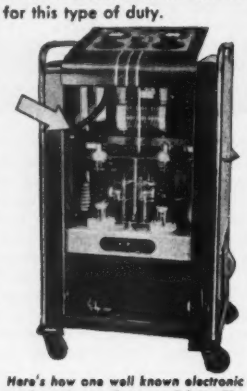

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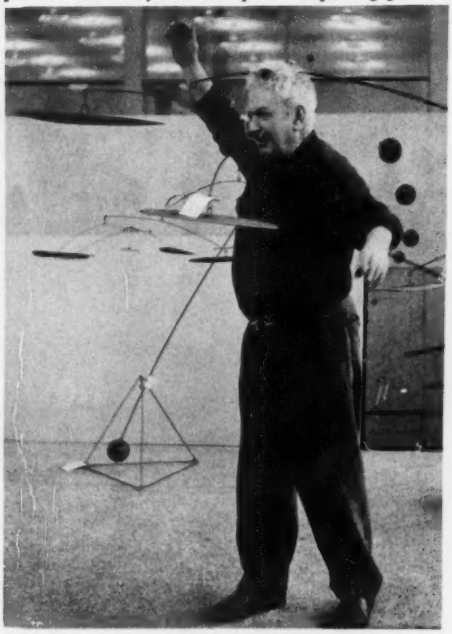
the art of calder

(*Continued from page 11*)

to Amsterdam, Rio de Janeiro, Stockholm, just last month London, and, of course, last December M. I. T. The reaction to him by the general public has varied. Some grant him originality; others call it aboriginality. Jean-Paul Sartre, a modern French writer, sums up a typical case of one who supports Calder and his works. Sartre feels that to appreciate "les objets de Calder" one must stand and study them, and follow the many patterns that they trace in space. A passing glance is

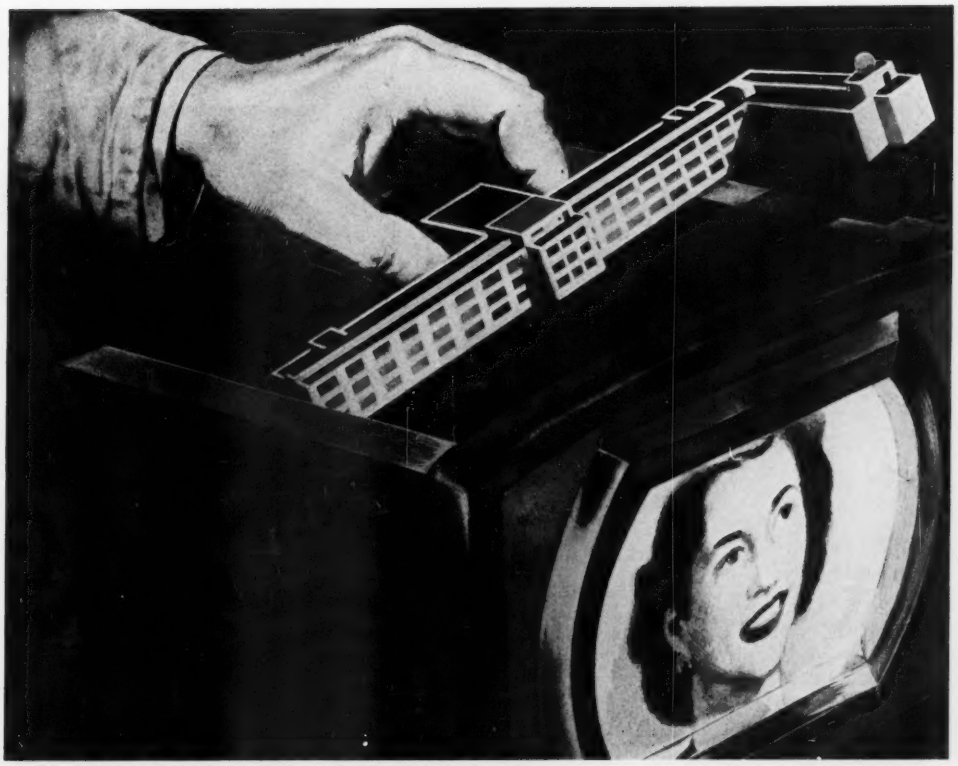


Always on the lookout for a laugh, Mr. Calder poses for our photographer while balancing a mobile on his head.

insufficient and hardly does them justice. It is in the many changing patterns they trace that they are fascinating. Once you miss a particular pattern you have lost it forever, for the mobiles are always beginning a new trail. Unlike sculptures and paintings, they do not suggest motion; they possess it. They suggest nothing; they are complete in themselves — "ils sont, voilà tout." Calder makes them in a certain manner and "c'est l'heure, le soleil, la chaleur, le vent qui décideront de chaque danse particulière."

I can easily visualize a modern home decorated with mobiles and stabiles. The motion picture that accompanies the exhibition emphasizes the similarity between Calder's mobiles and the magnificent yet commonplace phenomena of nature — the fluttering of leaves in a breeze, the splashing of waves over some rocks, or the reflection of the sun from a restless body of water. The spirit of these everyday occurrences is captured by Calder's mobiles, although he does not mean them

(*Continued on page 32*)



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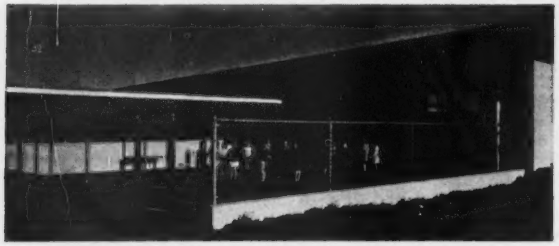

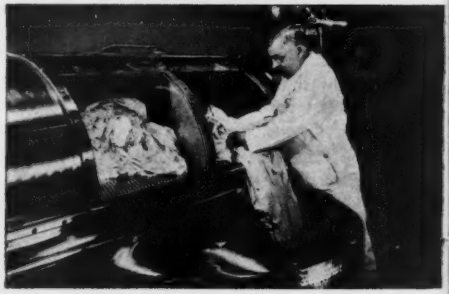

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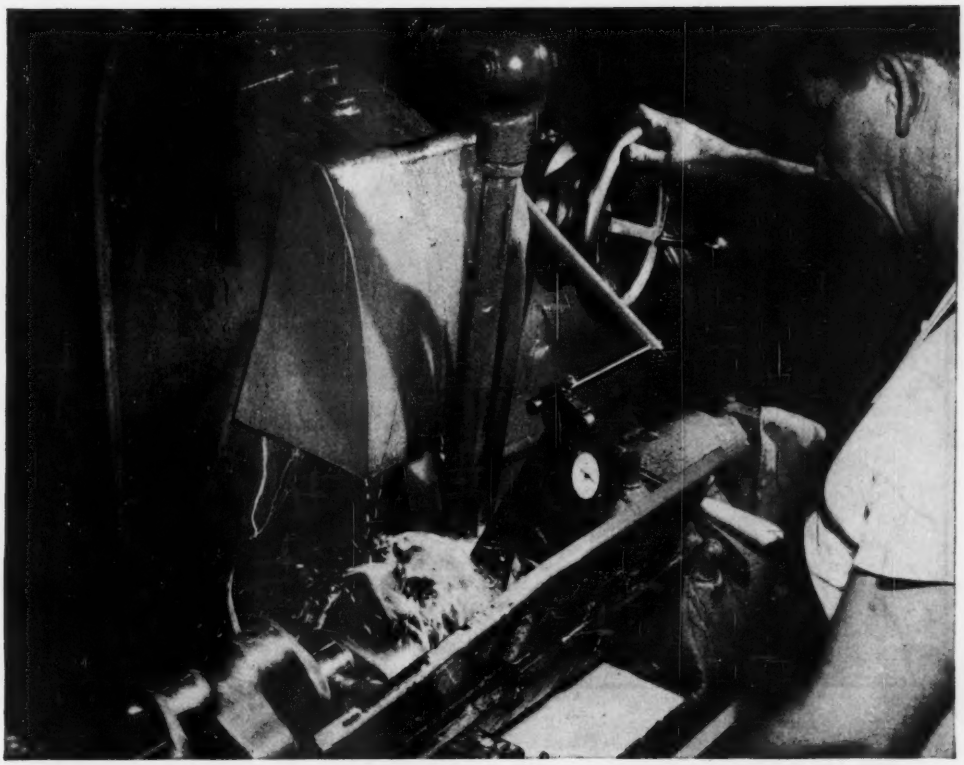

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THE LUFKIN RULE CO.
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the art of calder

(*Continued from page 30*)

to be an attempt to create nature artificially. I believe that the mobiles are able to set the same quiet peaceful atmosphere that is found so often in nature.

Beyond a doubt the background music of the motion picture did much to give a favorable impression of the whole idea; and when I proceeded from the movie to the display room, I felt rather let down and disappointed. A quiet background of music similar to that of the movie would have made the exhibition much more effective. Even as it was I felt sort of thrilled when I heard that gong sound from time to time. That mobile above all others I would like to own. To begin with it struck a note very similar to that struck by the great big bruiser that sounds the gong at the start of all J. Arthur Rank movies, and that alone is certainly foreboding and exciting. The idea of having this gong re-echoing throughout my house at unpredictable hours appeals to me very much.

By themselves most of the other mobiles left me unmoved, and unlike Sartre I failed to be fascinated by the infinite number of patterns each mobile traced; but taken as a whole the room was impressive. Viewing a group of them at once, big black stabiles casting shadows across fleeting white circles behind which a wire face leers, I found the display quite interesting.

I was surprised to learn that each mobile and stabile has a name. One of those big black stabiles is called "Black Beast"; another, "The Whale." A particularly mild white mobile, made especially for the M. I. T. exhibit, is named "Blizzard of December, 1950." You may recall the weather of last December.

Newsworthy Notes for Engineers

A touch of gold... a lot of Engineering!

GRID FRAME
(actual size)

This is the grid frame for an electron tube that plays a vital part in the Bell System's radio relay network for long distance telephone calls and television programs.

Across the central hole of a frame—between dotted lines—tungsten wires .0003 of an inch in diameter, so fine you can barely see them, must be placed with their centers .001 of an inch apart. How to fasten this wire securely to a frame posed a problem that took the combined skills of many kinds of engineers.

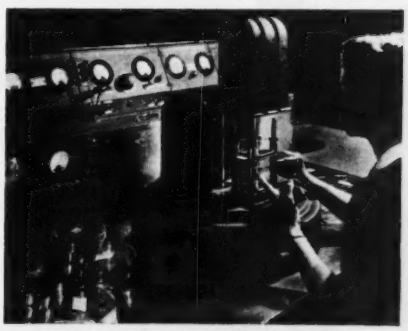
Electrical, Chemical and Metallurgical Engineers decided it could best be anchored with gold. Why gold? Because it is inert in a vacuum, reduces grid emission, is suitable for the working temperature of the tube and is a good electrical conductor.

Physicists, Electrical and Mechanical Engineers tackled this problem — and adapted the machine shown, in which frames are placed—forty at a time—on a two-level rack. Between the uprights of the rack are heating coils into which short lengths of 24 karat gold wire are placed. An air-tight cover is lowered, the chamber evacuated and heaters are switched on. When vacuum and temperature are just right, the operator passes a carefully controlled current through the coils and the gold vaporizes, covering the grid frames with a coating .00002 of an inch thick. Only about two and one-half cents worth of gold per frame is used.

Tungsten wire is next wound around two frames at a time. These are put into a hydrogen atmosphere and heated until the gold melts and brazes the wire firmly to both frames, which are then split apart.

Industrial Engineers made thorough job cost and time studies which show this new process is fast and economical.

Working closely together, Western Electric engineers of varied skills are constantly developing new, better and more economical ways to make telephone equipment. That's how they help the Bell System give this country the best telephone service on earth at the lowest possible cost.



This unusual machine turns gold into vapor to gold-plate little grid frames at Western Electric.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

USE THE WORLD'S BEST at NO EXTRA COST

Begin your career by doing what the masters do . . . use CASTELL with the famous *imported* graphite. It costs no more than ordinary domestic brands.

18 superlative degrees that match every mood of genius. Ask for CASTELL 9000 at your college supply store.

AW FABER-CASTELL PENCIL COMPANY INC. NEWARK 4, N.J.

impressions of the u. s. a.

(*Continued from page 13*)

why? They're all dead drunk. Never seen anything like it. Makes you want to throw up.'

"I almost threw up, but restrained myself and listened as the conversation continued.

" 'Of course not everything's like that, you know. Why, did you ever know that in New York there aren't any hunchbacks?'

"This is more than I can stand, and I put in the brilliant query, 'No hunchbacks?'

"'No hunchbacks! And do you know why? All the hunchbacks of New York — they send them to a city in the West. Nothing but hunchbacks there.'

"I tell him that I've been to New York, and that I've never heard such a fantastic story. This somewhat upsets him and he loses his authoritative air for a moment, but he soon recovers.

" 'Have you ever seen a hunchback in New York?' he asks.

"Now, when I'm in New York I never make it a special point to look for hunchbacks, so if I don't remember seeing any, what can I answer? Just then an idea permeates my traveling companion's original mind, and he wakes up his buddy who has probably been dreaming of those beautiful, drunk New York women.

" 'Hey Giovanni! Have you ever seen a hunchback in New York?'

" 'Nooo . . . ,' and Giovanni rolls back to sleep.

" 'See? Di'Giorgio! You ever see a hunchback in New York?'

"Giorgio mutters an almost incomprehensible 'no' and falls asleep again. I can see that I've almost lost my cause, but a fourth sailor passes the door of the compartment. My opponent opens the door.

" 'Gigi — Have you ever seen a hunchback in New York?'

"Gigi is evidently a sharp fellow, and he certainly wants to stand up for his buddy in any argument.

" 'Sure! There're hundreds of them!'

"It's not that often that I'm able to make people realize that, notwithstanding the differences in American and European life in general, America isn't a land of radically different people. Certainly Americans could do more to show Europeans what they are and how they live. But the most important thing is to get European visitors to see more than they do; to make them realize that there is more to America than New York; and to get them to meet American people. In this respect what has struck me here at Tech is the great number of foreign students. If more colleges tried to get an exchange of students, people of America and Europe would understand each other much better."

Another Italian, one who is looking forward to becoming an American citizen, writes:

"In expressing my opinion about the country which within five years is going to become my third fatherland, I should first of all emphasize the fact that what I know of it is very little.

"I know New York City — at least I think I do. However, I think that New York City is representative of what the whole United States stands for, since in this city more than anywhere else, a worldly spirit can be felt — a feeling of cosmopolitanism. Its inhabitants include people from every nation, which makes a stranger feel at home in a certain way, since he has the chance to meet people who talk his language and have his traditions. On the other hand he feels that he has come to the right place, since, although he lives in a melting pot, he is bound to acquire sooner or later those unique ways of behaving and thinking that are typical of an American.

"Thus myself, being young, I am bound to become American. I could not say that if I really did not want to become one. However, I know that it will be hard for me to forget about my 'old' country; nor do I actually want to forget about it, since I believe that an individual is more complete when he is manifold and not just one type of individual.

"I think furthermore that America is trying to build its youth too much in what I believe is a wrong direction. It is left up to the individual to broaden his horizon, to look for generalities, instead of merely forcing himself to specialize in one thing only. This, I guess, can be explained by the huge technological development America has undergone lately which requires specialists everywhere and does not leave very much left for what I would call the 'broadening of the general outlook on life.'

(*Continued on page 36*)

Something

in the way of

SPRING SERVICE

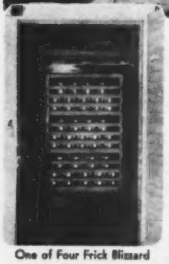
FREE PUBLICATIONS for reference in mechanical spring design.

1. "Handbook of Spring Design"
2. "The Mainspring," a periodical of current spring information
3. "Handbook of Spring Steel"

Please mention this magazine when making your request

Wallace Barnes Springs

Bristol Connecticut



One of Four Frick Blizzard Freezers

Another COMMUNITY REFRIGERATION CENTER

Selects FRICK Equipment

The Sodus (Michigan) Fruit Exchange processes 60 tons of fruit a day; quick-freezes up to 100 tons; stores 90,000 bushels; operates a locker plant; and sells all kinds of farm machinery, hardware, feeds, and fertilizers.

Two large Frick refrigerating machines, four Frick Blizzard freezers, and two big cold storage rooms now carry the major load.

Frick Second-stage and Booster Compressors at Sodus

Frick refrigerating, ice-making and air conditioning equipment performs similarly varied services everywhere.

The Frick Graduate Training Course in Refrigeration and Air Conditioning, operated over 30 years, offers a career in a growing industry.

FRICK CO.

Also Builders of Power Farming and Sawmill Machinery

science, man and music

(*Continued from page 14*)

George Gershwin then developed music expressing American institutions and ideals. Even continental composers dipped into American sources for their themes. World War II saw foreign composers fleeing from overrun countries to come here where they could do what they chose with music. Such outstanding composers as Schoenberg, Krenek, Hindemith, and Milhaud came to the United States and music in the new world became more deeply rooted than ever.

Today we must see music as more than an extraneous trimming to the materialistic world. It has become so widespread, has come to such a variety of uses, that its absence would make customs lose much of their color and importance.

When we mention that music has become widespread, it immediately brings to mind the radio from which music pours all day, and the phonograph by which any of the great artists can be called upon to perform whichever piece the listener may choose regardless of time or place.

It signifies this: the twentieth century American is tending toward realism rather than mere formality. He delights not in romanticist delusions, rather in realistic approaches. And the realist considers everything, most of all man, and him as a real being, wrought and effected by real forces. A nineteenth century music founded on fantasy and legend placed itself in a world different from science and its offspring technology and realism. But twentieth century music is based on science; its structure on technology, and its content on realism.

impressions of the u. s. a.

(*Continued from page 34*)

"Therefore I shall try to conserve what I acquired in my own country and Europe in general, and at the same time prepare to become a true citizen."

Both Indian students we asked to comment seemed amazed by the American pace. One writes:

" 'Rush' is a word which is not unfamiliar to an average American (especially to all Techmen). He uses it as much as the phrase 'taking it easy' but the former has a greater influence on an average American. Even when he is 'taking it easy' he has the habit to rush when he has to do something or other. It is very interesting in this country which produces perhaps the world's greatest time and labor saving devices that every person should have less leisure than a person in a country which is quite backward. Does that mean that the invention of time saving devices makes the man more conscious of the value and that the man's leisure hours are inversely proportional to such inventions?"

The other student from India says:

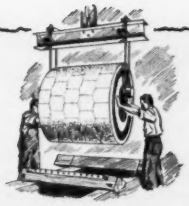
"Perhaps the most difficult thing for a foreigner to get used to is the terrific tempo of life led by the American citizens. From a young infant to an old man, the American citizen seems to exhibit an extraordinary concern over the rate at which things are done. Even the fairer sex prefers to be associated with aggressive young men who have mastered the art of shouldering their way through life in the quickest possible manner. It is no matter of surprise that most Americans are at an utter loss when they have a free moment of leisure. For the wonderful art of doing nothing (or taking it easy, as my friends here prefer to call it) is a long forgotten one. In fact I believe that if one were found to be genuinely interested in mastering one art or another in his spare time, he would very likely be considered fit to be a member of a lunatic asylum. Can it be that the Americans are aware of the fact that the busiest person in the whole universe is the Devil himself? Just imagine how much more peaceful would the world be if all the soldiers and the politicians of the world were desirous of taking it easy!"

A student from China finds our advertisements oppressive:

" 'Smoke XX cigarettes,' 'Buy Burmur Shaving XX,' 'A puff inhale and a puff exhale,' 'Let your eyes tell you why XXX television.' These sentences really annoy me. But if I wish to stay in America I must try to have the patience to accept them because they will catch my sight at every corner. As I look up, I see the advertisement made by an airplane 'Use LUX for your socks and underwears'; as I go underground, I see thousands of the same stuff again — ads, ads, and more ads. When I am driving along the highway, I just try to enjoy the fresh air, the cool breeze, and the beautiful scenery, thinking that I can escape from these tiresome advertisements for a moment. Then suddenly 'Buy XXXX fish cakes' strikes my eyes. Who wants to buy fish! This is certainly very discouraging."

Another Chinese student deplores the misconceptions about China that are prevalent in the United States:

"When I first arrived in the United States of America two months ago, I was very much surprised to learn most of the Americans misunderstood China very much. For instance they really think that chop suey and chow mein are a kind of pastry in China like hot dogs in the United States. The dishes you eat in Chinatown are more or less cooked in a Cantonish style which, in my opinion, is not the best in our country. That is not really Chinese food."



What's it for?

This 10-ton abrasive wheel helps produce which of the following?

- ☐ *Steel*
- ☐ *Paper*
- ☐ *Cement*
- ☐ *Coal*

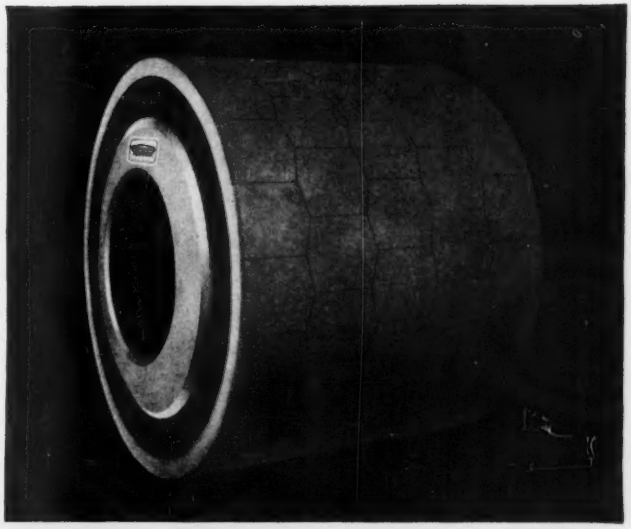
The answer is paper and the wheel is a Norton pulpstone, used in the grinding of wood pulp.

How It's Made

In the Norton pulpstone, abrasive segments are anchored securely to a reinforced concrete center, and staggered to comprise a continuous grinding surface. Depending on pulp requirements, the abrasive mediums are Crystolon* silicon carbide or Alundum* aluminum oxide, both trade-marked Norton products noted for their great hardness, sharpness and high resistance to wear. Joints between segments are made of a special material which is unaffected by continuous immersion in hot water and has a wear-resistance approximating that of the abrasive.

Advantages

Thanks to their scientific construction, and to the constant care that controls their manufacture, Norton pulpstones are, above all, quality producers. In addition, their extremely low wearing rates enable mills to obtain a higher yield of pulp per cord of wood and to reduce expensive, production-halting shutdowns due to stone replacements. That is why Norton pulpstones are preferred by wood pulp mills the world over.



John R. Erickson, B. S., Yale '33, checks a newly molded Reinforced Hub Wheel in the Norton Research Laboratory — Organic Section.

Worth Thinking About

Norton engineers and the facilities of Norton laboratories are constantly at work on new developments in abrasives, bonds, construction methods and applications. In other words, "making better products to make other products better" — for *all* industry. To the young technician, it is a constantly expanding, exceptionally inviting field — worthy of serious consideration when planning for the future.

Guy Irwin, Ph. D., Penn State '49, working on the development of ceramic bonds, examines vitrified grinding wheel under a binocular microscope.

*Registered trade-marks for Norton silicon carbide and aluminum oxide respectively.

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

ABRASIVES · GRINDING WHEELS · OILSTONES · ABRASIVE PAPER & CLOTH

GRINDING & LAPPING MACHINES · LABELING MACHINES · NON-SLIP FLOORING

REFRACTORIES · CERAMIC SURFACE PLATES · BORON CARBIDE PRODUCTS

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

BEHR-MANNING, TROY, N. Y. IS A DIVISION OF NORTON COMPANY

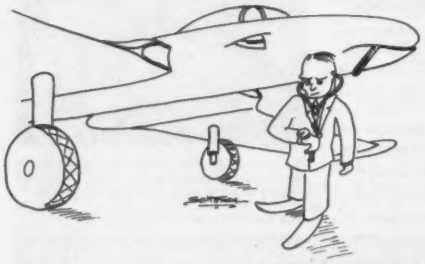
briefing the news

Temperature-Sensing Devices . . .

Efficient operation and adequate protection of the power plant in jet engines requires very rapid reduction in the temperature of the gas stream whenever this temperature exceeds a limiting safe value. The rates of response of whatever temperature-sensing devices are used thus assume considerable importance in jet-engine operation. Various methods for determining response rates have been worked out, but in most cases they have proved unsatisfactory because they failed to simulate operating conditions adequately.

Now there is available apparatus which determines the rate of response of jet-engine temperature elements under conditions very closely approximating those obtaining in the combustion stream. With this equipment, response times as short as 0.02 second have been measured for a wide variety of thermocouples, resistance thermometers and thermistors.

The rate of response, or "characteristic time," of a specific temperature element (defined as the time required by the element to undergo 63.2 per cent of the total change in temperature to which it is subjected) depends on its mass, surface area, and heat capacity, and on the rate at which heat is transferred to the element from the gases flowing through the engine. Thus, in any test system in which heat is transferred to the temperature element mainly by radiation or natural convection, the observed values would not be applicable to jet engines. Engineers therefore developed a system for studying characteristic times in which heat is transferred primarily by forced convection, as actually occurs in engines.



This apparatus consists essentially of a jet-engine combustor, or burner, with provision for mounting instruments in the exhaust gas stream, and a device for producing rapid changes in the temperature of the mounted test instrument. A compressor or blower supplies air to a single Jumo 004 turbo-jet engine combustor equipped with its normal fuel injector and spark plug. Exhaust gases from the combustor pass through two ninety-degree turns, through a perforated plate, and then through about ten feet of straight pipe before reaching the test section, which has three convenience hatches for mounting instruments. In this way, the gas stream is kept at essentially uniform temperature and velocity over the central half diameter of the test section, and exposure of any instrument to direct radiation from the flame is prevented by the turns in the duct system.

The gas temperature and flow rate at the combustor outlet are controlled by means of a valve at the inlet to the compressor and by adjusting the fuel pressure. A bleed line containing a butterfly valve also provides an auxiliary control of the flow in the test section, independent of the operating conditions of the burner. Pressures observed with a pitot-static tube, together with the known value of gas temperature, permit calculation of the mass flow rate in the test section.

For measuring rate of response, the temperature of the gas surrounding the test instrument must be changed very suddenly. This cannot be accomplished with sufficient rapidity by controlling the combustor. Apparatus was therefore developed for quickly immersing the instrument without altering the steady flow of exhaust gas in the test section. In this device, an Inconel tube, projecting vertically upward through the test section and held in position around the test instrument by a release plate, provides a flow channel for cold air. When the release plate is pulled out of the way, a spring suddenly removes the tube, exposing the instrument to the hot gas of the main stream almost instantaneously. During the downward movement of the tube, the supply of cold air is stopped automatically. In this way a test instrument at a known, moderate temperature (controlled by the air rate through the Inconel tube) can be brought in contact with exhaust gas at any given temperature and at any mass flow rate within the capacity of the system.

Stand for Quality
HIGGINS
Higgins non-tip rubber base keeps your Higgins American Waterproof India Ink upright. . . . Ask your dealer for both.
HIGGINS INK CO., INC.

A gun barrel made of glass . . .

This scientist is putting together the barrel of an "electron gun." When completed, it will be capable of developing cancer-killing rays at twice the power of those given off by all the medical radium in the world.

The barrel of the gun, part of a new super-voltage X-ray machine used in cancer research and treatment, is a tube formed by stacking precision-made rings of one of Corning's special electrical glasses.

Two million volts drive electrons through the tube, much as a bullet is driven through a gun barrel. As these electrons are suddenly stopped by a water-cooled block of gold at the end of the barrel, two-million-volt X-rays are generated. This X-ray beam is powerful enough to reach diseased areas four inches inside the body and it can be directed with great accuracy on the spot the doctor wants to bombard.

High Voltage Engineering Corporation, manufacturers of this generator, at first had difficulty finding a high-voltage electrical insulating material for the gun barrel, a material that would stand electron bombardment hour after hour without breaking down. The answer to their problem was a glass selected from the many developed by Corning to meet exacting electrical specifications.

Providing glass for medical research is not new to Corning. Since the early days of X-rays, glass by Corning has played a vital part in the development of X-ray apparatus —transmitting glasses for tubes and absorbing glasses for shields. And Pyrex brand laboratory and pharmaceutical glassware has served medical science since World War I.

Throughout industry, *Corning means research in glass*—research that has contributed in countless ways to better products and processes, and through them, to better living for us all.

That's why we suggest—when you're out of college and concerned with improving products or processes—that you consider glass, a material of practically limitless uses. And should you want to know more about Corning electrical glasses, or the hundreds of other glasses Corning makes, we hope you'll write us before your planning reaches the blueprint stage. Corning Glass Works, Corning, New York.

CORNING
means research in glass

THE DU PONT DIGEST

Bringing Up Alathon*

Du Pont scientists find great promise in this young member of the wax family

One of the most interesting and versatile of the new plastics is Du Pont "Alathon" polythene resin, chemical cousin of paraffin.

Because of its unusual combination of properties, it is now being used in everything from "squeeze-bottles" for toiletries to cable insulation and chemical-resistant linings.

"Alathon" was born when English scientists used high-pressure synthesis to create polythene, the solid and semi-solid polymers of ethylene. Du Pont scientists and others added their background in high pressure work to the field of ethylene polymers. This concerted effort produced a greatly expanded range of uses.

Taking First Steps

The first step of Du Pont chemists and engineers was to produce polythene in the laboratory to confirm earlier findings. Then the product was turned over to chemical engineers for pilot-plant work. Finally, a plant for full-scale commercial production was designed by chemical, mechanical and electrical engineers and metallurgists.

Many of the most promising uses for "Alathon" could not be realized until technical difficulties were overcome. For example, the chemical inertness, which is one of the outstanding properties of the material in film form, also made the casting of film from solution impractical because it could not be dissolved in suitable solvents. In devising a special extrusion technique to solve this problem, Du Pont engineers opened up a whole new field of possibilities.

Blow-molded "Alathon" *bottle, with molded closure. It emits a fine spray when squeezed.*

Multiwall bags *for chemicals and foods are made of kraft paper coated with "Alathon."*

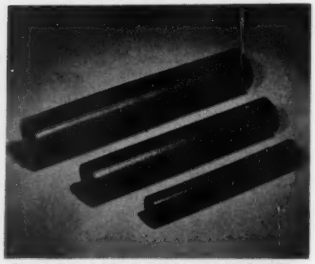
Acid-Defying Paper

In film form, "Alathon" lends its strength, chemical inertness and resistance to grease and moisture to packages for chemicals, foods, metal parts and moisture-sensitive powders. In still another form in which these properties are employed, paper coated with "Alathon" is used as wrapping for bakery products and moistureproof containers for chemicals that would attack uncoated paper. (Experimentally, "Alathon" coated paper has been exposed to concentrated sulfuric acid for days without harm; the same paper, uncoated, was ruined within a few minutes.)

The protection of "Alathon" was extended to metal tanks and drums when Du Pont engineers developed a spray-flaming coating technique.

In the field of electricity, too, "Alathon" is proving of great value. Its outstanding electrical properties make it an ideal insulator for wire and cable, particularly in the high-frequency applications necessary in television and radar.

All "Alathon"—*ice-cube trays, refrigerator bowls, tableware and protective coverings.*



Pipe *made of "Alathon" is used for handling corrosive chemicals, solutions and gases.*

"Alathon" in powder form is used for molding a wide range of light, tough and flexible plastic articles. In addition to bottles, these include tumblers, dishes, jar caps and ice-cube trays. Extruded as a film, it serves for garment covers, tablecloths and rainwear.

The future looks bright for "Alathon." New applications such as extruded pipe for mines and separators for storage batteries seem about to be realized. Other uses yet undreamed of will no doubt emerge from the close, continuous teamwork of technical men that typifies Du Pont research.

*REG. U. S. PAT. OFF.

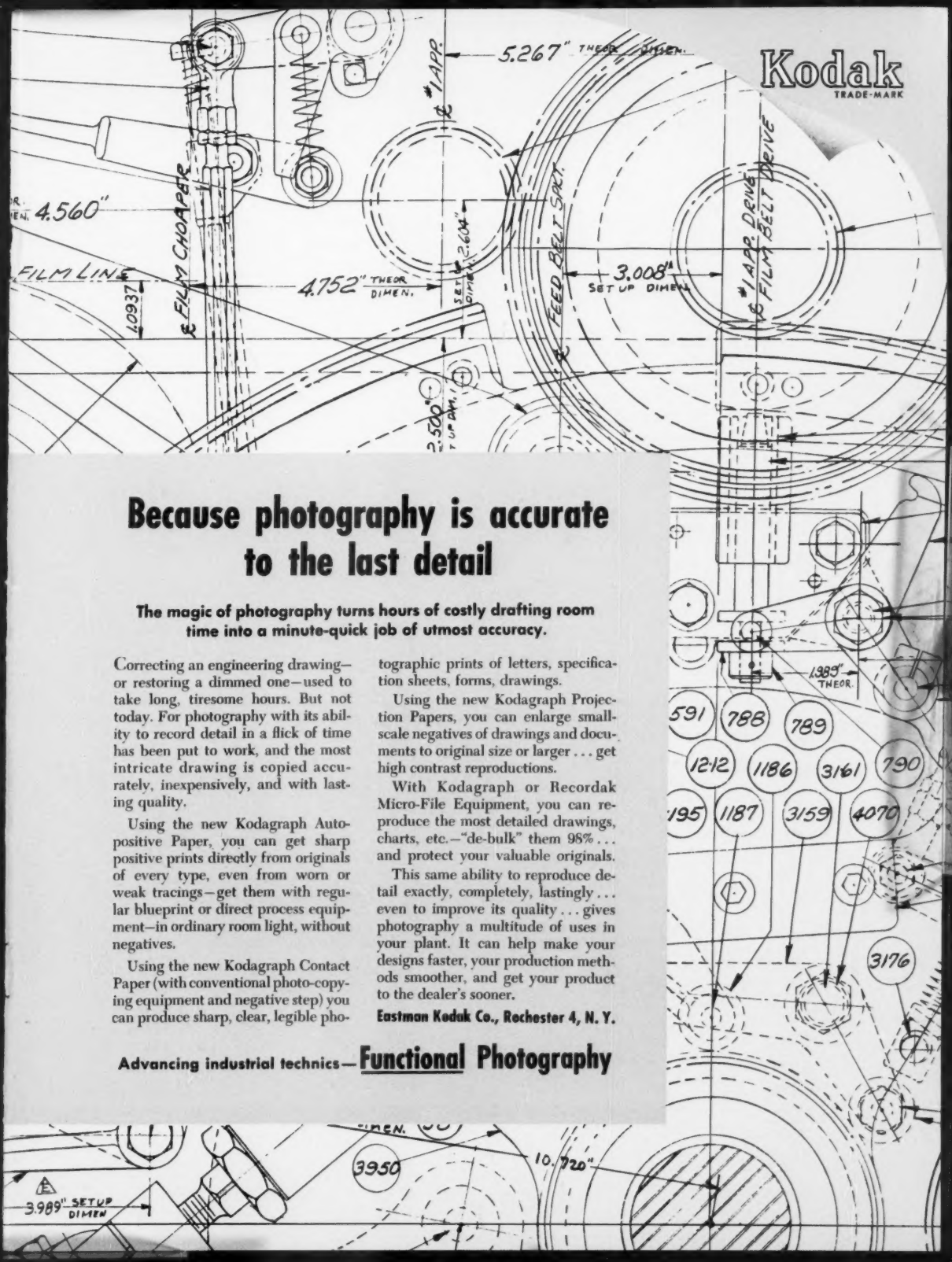
DID YOU KNOW . . .

six out of ten Du Pont plant managers and superintendents started with the company as chemists, analysts, technicians or engineers.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Entertaining, Informative — Listen to "Cavalcade of America," Tuesday Nights, NBC Coast to Coast



Because photography is accurate to the last detail

The magic of photography turns hours of costly drafting room time into a minute-quick job of utmost accuracy.

Correcting an engineering drawing—or restoring a dimmed one—used to take long, tiresome hours. But not today. For photography with its ability to record detail in a flick of time has been put to work, and the most intricate drawing is copied accurately, inexpensively, and with lasting quality.

Using the new Kodagraph Autopositive Paper, you can get sharp positive prints directly from originals of every type, even from worn or weak tracings—get them with regular blueprint or direct process equipment—in ordinary room light, without negatives.

Using the new Kodagraph Contact Paper (with conventional photo-copying equipment and negative step) you can produce sharp, clear, legible photographic prints of letters, specification sheets, forms, drawings.

Using the new Kodagraph Projection Papers, you can enlarge small-scale negatives of drawings and documents to original size or larger . . . get high contrast reproductions.

With Kodagraph or Recordak Micro-File Equipment, you can reproduce the most detailed drawings, charts, etc.—"de-bulk" them 98% . . . and protect your valuable originals.

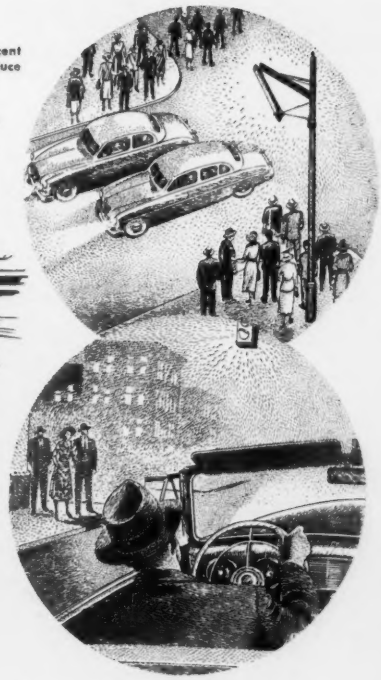
This same ability to reproduce detail exactly, completely, lastingly . . . even to improve its quality . . . gives photography a multitude of uses in your plant. It can help make your designs faster, your production methods smoother, and get your product to the dealer's sooner.

Eastman Kodak Co., Rochester 4, N. Y.

Advancing industrial technics—Functional Photography

Now streets can be lighted by G-E fluorescent lamps. The four lamps in each fixture produce 19,000 lumens of light.

Two entire communities have voted to let G-E Disposalls take care of their garbage. Young G-E engineer Gordon Roney (R.P.I., '36) has supervised installation.



New G-E electronic traffic control automatically adjusts time lights stay red or green to accommodate greatest traffic flow.

These G-E developments are bringing a "New Look" to American communities

Jasper, Indiana, has no garbage collection any more. It became the first town to get rid of garbage by letting General Electric Disposall® food-waste units grind it up and flush it down the drain. A young G-E engineer who has specialized in Disposalls since he came off the Company's "Test" course supervised the installation of Jasper's units and is now starting a similar job for Herrin, Illinois.

In Detroit, other G-E engineers have installed something new in street lighting—fluorescent street lamps. Used primarily indoors before, fluorescent lamps are now used to light a half-mile of the city's Wyoming Avenue. Their light is brighter, less glaring, and is expected to make driving safer.

Still other G-E experts have revolutionized Denver's downtown system of traffic-light controls. The new system counts passing cars and automatically varies the length of time that red and green lights stay on, thus adjusting the lights to changes in the traffic flow.

These are a few examples of the exciting new projects that are challenging young G-E engineers today. General Electric's leadership in research and engineering makes it a place where college graduates are finding increasing opportunities to engage in highly interesting and satisfying work.

You can put your confidence in—

GENERAL ELECTRIC